

Land, food and labour in pre-industrial agro-ecosystems: a socio-ecological perspective on early 19th century seigneurial systems

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Research on seigneurial agriculture and its role for agricultural changes in general has a long tradition within European Agricultural History. Still, much discussion arises on whether to emphasize «peasant paths» or “landlord paths” of agricultural development. This study contributes to the debate by introducing a social ecology perspective. Using the nineteenth-century case study of Grundherrschaft (manor) Grafenegg, we offer a first attempt at conceptualizing and empirically scrutinizing resource use and distribution in (late) Central European seigneurial agriculture. We integrate rich archival material to reconstruct the distribution of three central resources –land, food and labour– among the agrarian agents (e.g. manorial farmsteads, peasant farms and smallholdings). We found that the three central resources in pre-industrial agriculture were distributed unequally between the various farmsteads involved; labour was abundant, whereas food and land were scarce. The labour surplus extracted by the landlords caused subsistence pressure on most of the peasants, forcing them to use their modest resource base more efficiently, which in turn had effects on the local agroecology.

Tierra, alimentación y mano de obra en los agroecosistemas preindustriales: una perspectiva socioecológica de los sistemas señoriales de principios del siglo XIX

PALABRAS CLAVE: desigualdad social, desarrollo agrícola, señorío, extracción de excedente, escasez de recursos.

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La agricultura señorial y su papel en el cambio agrario ha sido ampliamente estudiada en la Historia Agraria Europea. Incluso el énfasis en la vía campesina o la vía latifundista del desarrollo agrícola se encuentra todavía en proceso de discusión. En este artículo contribuimos a este debate a partir de la perspectiva de la ecología social, mediante una primera tentativa de conceptualizar y analizar empíricamente el uso y distribución de los recursos en la tardía agricultura señorial de Europa central (el señorío «Grafenegg»). A partir de un rico material de archivo reconstruimos la distribución de tres recursos centrales (tierra, alimentos y trabajo) entre las explotaciones señoriales, las campesinas y las pequeñas explotaciones. Constatamos que estos tres recursos estaban distribuidos de forma desigual entre las distintas unidades de explotación; mientras que los alimentos y la tierra escaseaban, el trabajo era abundante. Por otro lado, el excedente extraído por los terratenientes generaba una seria presión sobre la subsistencia de la mayor parte del campesinado. Así, la situación de escasez obligaba a los campesinos a usar su modesta base de recursos de forma más eficiente, lo que tenía efectos sobre la agroecología local.

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1. INTRODUCTION

Without any doubt, we may find many among the villains, who are diligent in nature and blessed with skills needed for flourishing agriculture. Only the sad memory that the cottage he is inhabiting, the field he is cultivating and the trees he had planted do not belong to him, but to his liege lord, who [...] may expel him from the land, withdraw his belongings or do even worse things; this memory, I claim, creates an inescapable inertia, discouragement and lethargy so that he stands and leaves everything and only pursues what is absolutely necessary (Wiegand, 1776: 20-21)¹.

In 1776, Austrian agricultural reformer and physiocratic writer Johann Wiegand published his observations on the hardships of seigneurial agriculture. In line with many agricultural reformers of the time, Wiegand strongly criticized the absence of peasant land ownership within Austrian seigneuries (Feigl, 1998b). According to his ideas, if peasants formally owned the plots they were cultivating, the whole agricultural sector would flourish. Johann Wiegand's observations serve as a vivid example of contemporary agricultural and political discourse all over the Habsburg Empire. Peasant economies were considered economically unsuccessful and incapable of any agricultural development or improvement. Also, seigneurial structures and traditional feudal bonds were debated as prime reasons for rural backwardness in the 18th and 19th century Austria (Gutkas, 1982: 4). Incentives for peasants to modernize farmsteads and intensify land use on their plots (*Rustikalland*) were considerably low, as they were bound to deliver substantial fractions of their agricultural produce to feudal lords (*Zehent*). In addition to physical (and/or monetary) rent-taking, compulsory labor (*Robot*, or *corvée* in French) impeded efficient and continuous cultivation of their own fields (Feigl, 1998b: 258). These seigneurial interventions into peasant agriculture regularly led to fierce disputes and violent conflicts all over Austria (Winkelbauer, 1986). In sharp contrast, manorial farmsteads were among the first to adopt the "New Agriculture" on their demesne lands (*Dominikalland*) (Mazoyert & Roudart, 2006: 375-440). They introduced new crops (e.g. potatoes, turnips, clo-

1. Translated by the authors: *Es ist kein Zweifel, daß unter den leibeigenen Unterthanen sowohl als unter den freyen, sehr viele gefunden werden, die mit einem fleißigen Naturell, und mit all den Eigenschaften begabt sind, die einen Landwirth glücklich machen können. Allein die traurige Erinnerung; daß diejenige Hütte, die er bewohnt; daß Feld, so er bearbeitet; und die Bäume, welche er gepflanzt, nicht sein Eigenthum, sondern seines Herren sind, der ihn nach Wohlgefallen, oft auf Angeben eines abgeneigten Beamten, davon verstossen, wegnehmen und in noch unseeligere Umstände versetzten kann: diese Erinnerung, sage ich, erregt in ihm eine unvermeidliche Unlust, schlägt seinen Muth nieder, und macht den Geist verdrossen, und unwirksam, den Körper aber träge und zuletzt faul, daß er alles gehen uns stehen lässt, wie es ist, und höchstens nur dasjenige tut, wozu er durch die alleräußeste Noth gezwungen wird.*

ver), used new farming techniques and devices, shortened or even abandoned fallow periods and explored more efficient manure management practices long before peasants (Gutkas, 1982: 3). These changes in production led to rationalization, intensification and commercialization of manorial farmsteads in the first half of the 19th century (Bruckmüller, 1977: 23). The seigneurial demesnes were among the first Austrian farmsteads turned into early forms of “rational”, market-participating agro-businesses (*Ibid.*: 49). Thus, manorial estates impeded agricultural development by draining peasant productivity through rents and compulsory labor, and at the same time, they were the very agents of agricultural change in their own enterprises.

2. “LANDLORD PATHS” AND “PEASANT PATHS”: A SOCIO-ECOLOGICAL PERSPECTIVE ON AGRICULTURAL MODERNIZATION

Research on the complex interactions between lords and tenants within seigneurial systems has a long tradition in European Agricultural History². Also, the role of demesne and peasant agriculture in the unprecedented rise in arable productivity –which is closely related to the Western transition towards capitalism– has gained enormous academic attention over the last decades. This debate on either “Peasant Paths” or “Landlord Paths” of agricultural modernization still remains a matter of open dispute (Hussain & Tribe, 1983; Byres, 2003). For England, Bruce Campbell depicted the role of medieval landlords central to the advent of agrarian capitalism:

Lords differed from other agricultural producers in the scale and relative factor endowments of their respective production units. The feudal system ensured that lords generally enjoyed privileged access to land, coercive powers over labor and often a superior command over capital. Lords held their lands on more generous terms than other producers, especially unfree tenants, and their individual demesne farms were commonly operated as components of federated estates. [...] As “firms” many were therefore both horizontally and vertically integrated and consequently enjoyed significant scale economies (Campbell, 2000: 55).

2. For the central and eastern European discussion on seigneurial systems we recommend CERMAN (2004), PETERS (1997), RÖSENER (1995), SCOTT (1998) and TOPOLSKI (1994). CAMPBELL (2000), DODDS (2008), HARE (2006), SAPOZNIK (2013) and SCHNEIDER (2014) provide wonderful insights into the British debates, whereas ACHILLES (1965), HAGEN (2002), HARNISCH (1980), HENNING (1969), and NORTH (1988) introduce the German discourse. For further reading on the Agricultural History of Austrian seigneuries we recommend DOPSCH (1904, 1910), DROBESCH (2003), FEIGL (1998a), GRÜLL (1975) and KNITTLER (1989, 1993).

We find many advocates of the “Landlord Path” in the European (Brenner, 1976; Byres, 2003) and Non-European historiography (Wolf, 1966; Geertz, 1971). In critical reaction to the English debates, Robert C. Allen’s seminal contribution (1992) on interactions between the enclosure movement and yeoman economies strongly challenged the assumption that agricultural modernization took place on demesnes exclusively: *Large farms were not necessary for bountiful harvests. Moreover, the rise in yields preceded the eighteenth-century shift to large “capital” farms. It was small-scale farmers in the open fields – the English yeoman – who accomplished the biological revolution in grain growing (Ibid.: 18).* Drawing on the English example, the “Peasant Path” literature gained momentum (Netting, 1993; Bavel & Thoen, 1999; Fertig, 2013; Parcerisas, 2014). Recently, the “Path to Capitalism” discourse came under attack for its inherent dichotomy, which many scholars suggested should be replaced by a more gradual concept of agrarian change emphasizing the intricate socio-economic and institutional relationships within seigneurial agriculture (North & Thomas, 1971; Jonsson & Pettersson, 1989; Vanhaute, 2008; Bavel, 2010; Béaur *et al.*, 2013). In this paper we will add to this debate with a local case study from the Habsburg Monarchy. Using two promising sources from Austria’s Agricultural History, we present a broad array of empirical material on seigneurial agriculture. Based on a socio-ecological framework, we use the data generated to reconstruct crucial aspects of resource use and distribution for Austrian agricultural development.

Our research starts from a single premise: Agricultural endeavors cannot be adequately understood without considering their vitally important interactions with ecosystems, *i.e.* the biological resource base of every agrarian activity (Mazoyert & Roudart, 2006: 21). Therefore, we will conceptualize seigneurial agriculture as a historical phenomenon at the intersection of economy and ecology, as a hybrid between nature and culture (Fischer-Kowalski & Weisz, 1999). To accomplish this, we will turn towards the interdisciplinary field of “Social Ecology”³. This theoretical and empirical approach builds on the manifold biophysical interactions between socio-economic systems and their surrounding ecosystems. A socio-ecological understanding of agriculture involves the flows of crucial resources (material, energy and nutrients) crossing the boundary between farming communities and the agro-ecosystems belonging to them. To warrant steady flows of resources for societal purposes, farmers invest labor to make use of land –and other natural resources– and actively intervene in agro-ecosystem dynamics. Therefore, this approach considers monopolization and cultivation of land as the prime goal of farmers, since the

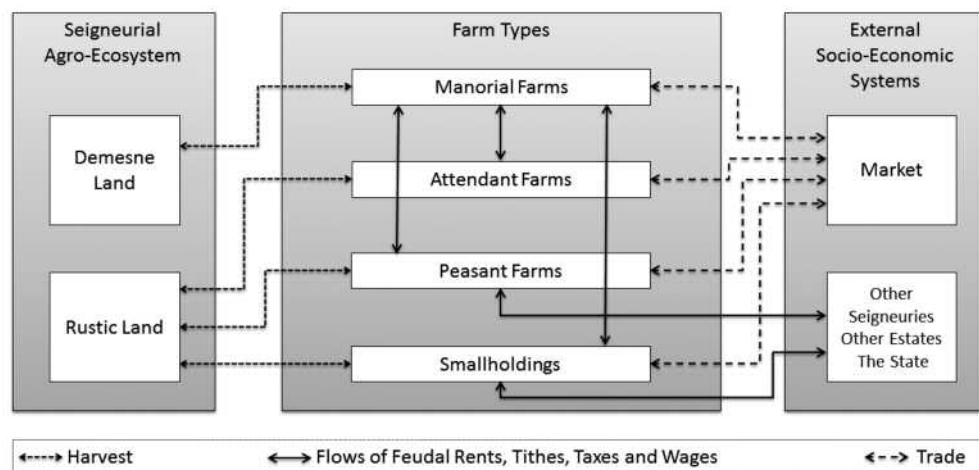
3. Concepts and methods derived from Social Ecology have been recently applied within historical disciplines (GONZÁLEZ DE MOLINA & TOLEDO, 2014; SINGH *et al.*, 2013), resulting in various case studies across different temporal and spatial scales (CUNFER, 2005; GUZMÁN & GONZÁLEZ DE MOLINA, 2009; GINGRICH & KRAUSMANN, 2008; KRAUSMANN, 2004; TELLO *et al.*, 2012, 2014; WINTWARTER & SONNLECHNER, 2001).

land ultimately limits the availability of (food) energy for the farming community (Fischer-Kowalski *et al.*, 1997; Fischer-Kowalski & Haberl, 2007; González de Molina & Toledo, 2014). To shed more light on the biophysical relations within Austrian seigneurial systems in the first half of the 19th century, we analyze the distribution of the three central resources between the most important agrarian agents: 1) land tenure, legally regulating access to the resource base for every agricultural endeavor; 2) food production, to assess the availability of nutritional energy needed to maintain collective and individual metabolisms of lords and peasants (Giampietro, 2004: 339–41); and 3) the potential labor time invested to produce all goods and products for the maintenance of the seigneurial system.

3. AUSTRIAN SEIGNEURIES AS SOCIO-ECOLOGICAL SYSTEMS

Drawing on an elaborated and empirically tested model on the social ecology of preindustrial agriculture in Austria (Krausmann, 2004: 741), we offer a systemic understanding of the most important socio-ecological relations between farmers and lords, their farms, animals and fields in Habsburg seigneurial agriculture in the 19th century (Figure 1)⁴.

FIGURE 1
Biophysical exchange processes in seigneurial systems



Sources: NÖLA (1823a–e, 1829a–g, 1830a–r), *Gutsverwaltung* Grafenegg (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

4. Similar modelling approaches were used in BAYLISS-SMITH (1982), KRAUSMANN (2008) and WI-NIARTER & SONNLECHNER (2001).

Even though seigneurial systems in Austria may be understood as a complex amalgam of different legal and constitutional elements, their most striking characteristic was *first and foremost a lord's right of disposition over land* (Brunner, 1981: 207)⁵. This idea of “land lordship” (*Grundherrschaft*) indicates that lord-peasant-relations were primarily organized along a spatial hierarchy. “Seigneurial Agro-Ecosystem” (Figure 1) reflects this hierarchy and refers to the sum of all cropland, grassland, gardens, vineyards and woodland legally controlled, cultivated and leased by a given landlord family. On the one hand, the land-owning aristocracy resided on their inherited demesne. Demesne lands may have been dispersed over a considerably large territory within the land system at stake. The seigneurial center included the castle district and other representative buildings, manorial farmsteads, commercial infrastructure and manufacturing facilities. Additionally, demesnes contained extensive arable lands, grasslands, gardens and vineyards, parks and also forestland for lumbering and hunting, which were more or less dispersed across the whole territory of the seignury. “Demesne Land” (Figure 1) refers to the fraction of the seigneurial agro-ecosystem directly cultivated by the manorial farmsteads. On the other hand, peasant farms usually included small residential facilities, a kitchen garden, and plots of arable land, meadows and –sometimes– economically important vineyards. Also, they might have legal access to common pool resources, *e.g.* grazing areas close to the village or common forests. “Rustic Land” (Figure 1) denotes the share of the seigneurial agro-ecosystem directly leased to and cultivated by seigneurial subjects.

Within seigneurial agriculture, different “Farm Types” followed different agricultural subsistence strategies. “Manorial Farms” undertook primarily market-oriented agriculture, viticulture and forestry on demesne lands. In many cases they also invested in manufacturing activities (*e.g.* brick production in our case study) to supply domestic or external demand. “Attendant Farms” primarily provided labor for the management and reproduction of demesne cultivation (*e.g.* organizing manorial food stocks and supplies, serving as forest officials, taking care of the manorial vineyard or livestock breeding enterprises). In return for their services within the demesne economy, manorial attendants received wages in money and/or kind by the landlords. Cultivating small plots of leased land only provided for an additional, secondary income⁶. In contrast, the cultivation of rustic land was the main subsistence strategy of “Peasant Farms”, which varied substantially in terms of endowment with land, livestock and other production factors. In ad-

5. HEISS (1989: 39-76) discusses Brunner's biography in the context of denazification in post-war Austria. Even though Brunner favored Third Reich ideologies, we finally decided to include his academic contributions on seigneuries, as they have fundamentally influenced Austrian debates in the last decades.

6. Attendants undertaking own small scale agriculture seems to be the exception, rather than the norm within 19th century (Lower) Austrian agriculture (BAUER, 2014).

dition to rustic cultivation, peasants were obliged to provide compulsory labor (*corvée*) and/or wage labor time to manorial farms on demesne lands. “Smallholdings” were endowed with considerably less land than peasant farms (but with similar farm sizes as the attendants), often barely enough for subsistence. The prime resource use strategies on smallholdings were horti- and/or viticulture and –to a lesser extent– animal husbandry.

After having defined the compartments of the system we turn towards the most important flows of agricultural products (*i.e.* biomass) within the system. “Harvest” refers to the aggregate sum of all biomass extracted from the environment (Singh *et al.*, 2010). Harvest flows reflect all the biomass extracted (primary crops and by-products, hay and grazed biomass, forested biomass, litter rough grazing in woodlands, etc.) and entering the farm types, where it gets processed, stored and distributed. As the arrows in both directions indicate in Figure 1, it is important to recognize that some biomass resources are also returned to the agro-ecosystem. *A key feature of agro-ecosystems is that some amount of biomass flows taken from the land is reused within the land system as an investment into the maintenance of its basic funds and services* (Giampietro, Mayumi & Sorman, 2013: 142). This includes seeds, manure, stubble and crop residues applied on demesne and rustic arable land. In addition to cultivation of their demesne lands, seigneurial agriculture was characterized as a relationship of physical and monetary payments of rents and wages exchanged between lords and subjects. Landlords aimed at collecting considerable fractions of biomass produced by peasants. To account for these biophysical flows we introduce “Feudal Rents, Tithes, Taxes and Wages”, which refer to all materials exchanged between seigneurial farmsteads (*e.g.* *Zehent* and other feudal obligations). In addition to this physical and/or monetary rent taking and wage receiving, peasants were obliged to *perform unregulated labor services [...] on demesne farms* (Landsteiner, 2011: 269). To meet labor requirements on the large demesne lands, landlords exerted their seigneurial rights to access labor services provided by the peasantry (*i.e.* compulsory *corvée* labor, not included in Figure 1). In return for the work performed on demesne lands and manorial farms, the peasants received a fraction of biomass available as wages in kind. Additionally, we have accounted for biophysical interactions of the seigneurie with “External Socio-Economic Systems” (Figure 1). Engagement on local and/or regional markets and tax and tithes obligations with other seigneurial systems, Austrian estates or the Habsburg central authorities may have significantly altered local resource use in seigneurial systems. Finally, we included trade flows in our model to account for exchange of materials via local and regional markets. The socio-ecological model of seigneurial agriculture lay the groundwork for establishing consistent and comparable indicators on the distribution of food, land and labor within the local system.

4. HABSBURG LAND SURVEYS, MANORIAL BOOKKEEPING AND BIOPHYSICAL RELATIONS OF PAST FARMING SYSTEMS

To reconstruct biophysical relations within seigneurial agriculture we have integrated two different bodies of archival material –the fiscal source *Franziszeischer Kataster* (FK) and manorial accounting records *Naturalhauptbuch* (NHB). In 1817, Habsburg Emperor Franz I. mandated a comprehensive land survey project covering the whole Habsburg Monarchy. Unlike earlier (and mostly incomplete) attempts in the 18th century, the cadaster provided a relatively solid and scientifically valid basis for tax calculation across the empire (530,000 km² in total) (Bauer, 2014: 6). From 1817 to 1856, Habsburg expert commissions undertook a series of geodetic field surveys on the level of single land parcels for each of the *Katastralgemeinden* (cadastral communes or villages, KG) in the provinces. Numerous maps (scale 1: 2.880) were created, showing landscape elements down to a 1m resolution (Sieferle *et al.*, 2006: 345). After the field survey, physical gross yields were estimated along different types of land use classes (*e.g.* arable I = highly productive, arable IV = poorly productive). In a next step, economic net yields were calculated based on 1824 prices and average production costs in the region (Krausmann, 2008: 4). In close cooperation with political representatives from the communes, tax commissions compiled a variety of additional documents, including the *Catastral Schätzungs-Elaborate* (Cadastral Elaborate, CSE) which provides a detailed description of each village. Information on topography, population, annual yields, rotation systems, manuring practices, livestock numbers, regular diets, etc. were also recorded. The *Grund- und Bau-parzellenprotokolle* (Parcel Protocols, PP) were produced in parallel to the land survey and provide information on landownership, size and land use type on the level of single parcels, as well as information on buildings. Taxes issued remained a matter of permanent dispute between central authorities, commissioners and villagers. While land use data provided in the cadaster can be considered accurate, reported yields probably represent long term averages at the lower end of the range. Still, our case study region was the first to be surveyed in the entire Monarchy and data may thus be considered quite accurate (Bauer, 2014: 40-1)⁷.

The *Franziszeischer Kataster* is one of the most important sources for agriculture and land use within Austrian historiography, as it provides rich information on quantities and qualities of peasant agriculture at the onset of the industrial transformation. Still, it lacks

7. www.franziszeiskerkataster.at gives a comprehensive –yet incomplete– bibliography, including Social, Economic, Agricultural and Legal History. For further reading on the Franciscan Cadaster we recommend LENDL (1967), MORITSCH (1970), SANDGRUBER (1979), KRAUSMANN (2004) and MARQUART (2006).

detailed insights into the relationships between lords and peasants, and between demesne and rustic agriculture. For this we have turned towards another promising –yet under-researched– source for Agricultural and Environmental History: *Naturalhauptbuch* (NHB)⁸. These manorial bookkeeping records were issued by seigneurial bailiffs administering demesne agriculture and provide for comprehensive data on manorial agriculture. They give detailed accounts on annual stocks, inputs and outputs to and from the manorial farmsteads, *i.e.* the centers of demesne cultivation. NHBs are organized to reflect the major agricultural activities during the harvest year. For example, the first major section deals with revenues from cropland (harvest, tithes, imports...), followed by expenses (seeds, wages, exports...). Similarly, NHBs report on crop residues, legumes, hay and straw production, livestock numbers and products, viticulture, forestry and manufacture (in our case, textile and brick making). We have extracted information on physical flows (reported in mass and volume units) from seven NHBs available (*Gutsverwaltung* Grafenegg, 1815, 1817, 1818, 1820, 1825, 1830, 1835). NHB accounts form a robust fundament for the reconstruction of manorial agriculture. According to Campbell, *Bailiffs' accounts represent one of the most remarkable compilations of agricultural data ever devised, and in respect of seigneurial demesnes provide all the information necessary for the direct measurement of both arable and pastoral productivity* (Campbell, 1983: 37). Still, the source also faces a number of limitations, as NHBs do not contain any information on land use, demography and monetary stocks and flows. Manorial management and accounting need to be understood as a socially embedded process that produces biased outcomes (Carnegie, 2014). As Planas and Sagner (2005: 174) argue,

In the case of agrarian activities, the peculiarities of their production process (especially the high level of the reuse of inputs within a unit of production) tend to make accountancy a very selective tool. In the historical archives, accountancy records listing all the inputs and outputs involved in the agrarian cycle are never found. Often, only a small portion of activities and goods are converted into precise listed quantities accessible to the different agents who participate in the production process.

For our purposes, we decided to include NHB information in our estimations, as the accounts reflect the most important agricultural flows represented within our model.

We used FK and NHB information to assess the distribution of land, food and labor between the different farm types involved in seigneurial agriculture. To achieve this, we

8. Even though Forschungsinitiative Umweltgeschichte (1999) comprehensively studied manorial sources, NHB was not considered.

had to integrate information at the village level (from CSE), at the level of individual peasant farms and parcels (from PP) and for the entire seigneurial economy (from NHB). Table 1 gives an overview of the sources used to investigate the unequal distribution of central resources⁹.

TABLE 1
Socio-ecological accounting procedure
(FK: Franciscan Cadaster; NHB: *Naturalhauptbuch*; PP: Parcel Protocol)

Socio-Ecological Parameter	Assumption and data processing	Source(s)	Scale
Land Use	Accurate representation	Cadastral Maps from FK	Village, Parcel
Land Tenure	Parcel numbers on maps and protocols fit	PP	Farm, Parcel
Net Food Production (Landlords)	Gross Production + Feudal Rent + Imports - Seed - Processing Losses - Wages in Kind - Exports	NHB & FK	Farm
Net Food Production (Peasants)	Gross Production + Wages in Kind - Feudal Rent - Seed - Processing Losses	FK & NHB	Village
Food Demand	3.36 GJNV per capita and year	Freudenberger (1998)	Capita
Village Population	Negligible population changes from 1778-1830s	<i>Gutsverwaltung</i> Grafenegg (1778) & FK	Village
Household Size	Average household size and share of agricultural workforce (including children and elderly people)	Schaschl (2007); Sieferle <i>et al.</i> (2006)	Farm
Labor Supply	10 working hours per capita and day 298 working days per capita and year	Schaschl (2007); Sieferle <i>et al.</i> (2006)	Capita
Labor Demand	Sum of average working hours per land use type, per animal species and maintenance of relevant infrastructure	Hitschmann (1920)	Farm

Sources: NÖLA (1823a-e, 1829a-g, 1830a-r), *Gutsverwaltung* Grafenegg (1778, 1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

5. GRUNDHERRSCHAFT GRAFENEGG (GG): A LOWER AUSTRIAN SEIGNEURY IN PERSPECTIVE

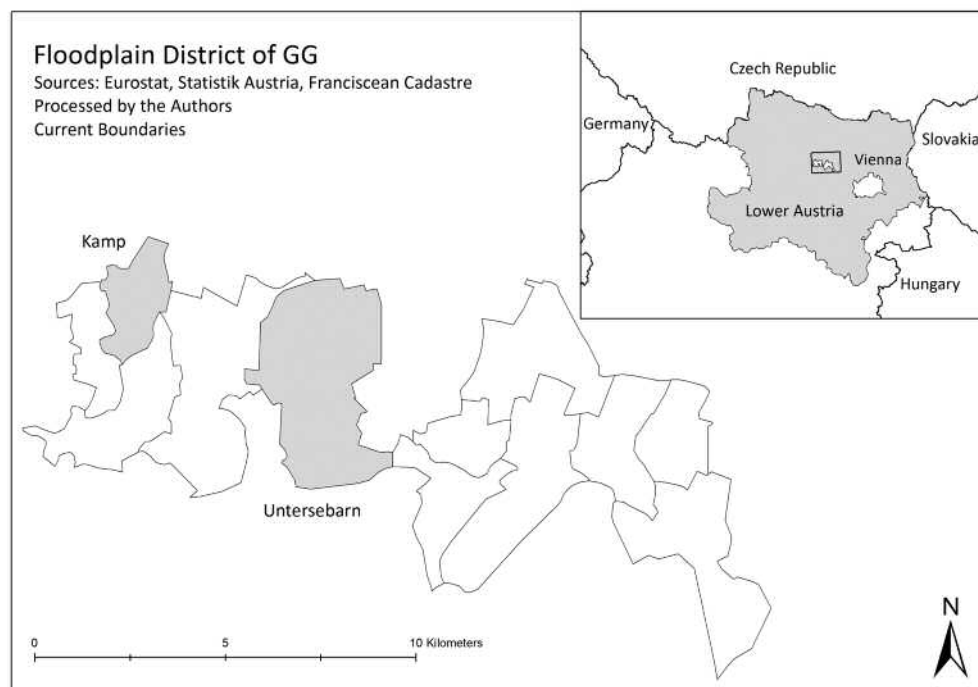
In the first half of the 19th century, agriculture was the predominant economic sector of the Austro-Hungarian Empire. In sharp contrast to other Western European empires such

9. For a more detailed description of the methodology employed –and also its shortcomings– please see the Appendix.

as England or Prussia, industrialization, commercialization and urbanization gained momentum slowly. Therefore, the Habsburg Monarchy has often been considered a “late-coming” country to Early Modern socio-economic modernization (Sieferle *et al.*, 2006: 249). Grafenegg Manor (*Grundherrschaft* Grafenegg, GG) was located in the center of Lower Austria, one of the Habsburg core provinces (Figure 2). Main features of the Early Modern agricultural revolution were nearly absent in Lower Austrian agriculture. Land and labor productivity remained stagnant at least until 1848 (Sandgruber, 1982). Even though soil conditions were favorable, contemporary writers of the late 18th century observed a *still very moderate* practice of agriculture (Fink, 1964: 973). For instance, topographer Joseph Marx von Liechtenstern (1791: 107) complained that new crops, modern technologies and animal manure were scarce, while fallow land was still abundant. Also, agricultural practices in Lower Austria were still heavily influenced by seigneurial norms and traditions (Gutkas, 1982: 4).

FIGURE 2

The location of Grafenegg Manor within Europe, the main map shows the boundaries of the cadastral communes in the floodplain district and the location of the two case study villages



Sources: Eurostat, Statistik Austria, Franciscean Cadastre; processed by the authors.

Documentary evidence on *Grundherrschaft* Grafenegg may be traced back to the end of the thirteenth century. Early landlords exerted comprehensive seigneurial privileges and power over approximately twenty villages within the province. In 1696, GG and associated territories were legally consolidated, as landlord Johann von Enckevoirt declared the seignury a so-called *Fideicommiss*, so that the seignury could only be inherited by his noble family and as an inseparable and inalienable administrative unit (*entailed estate* in English, *mayorazgo* in Spanish). Still, Enckevoirt control only lasted until 1730, when the last daughter was married to Anton Breuner (*Verein für Landeskunde*, 1893: 625-637). Under Breuner reign, which lasted until the liberal reforms of 1848, Grafenegg became one of the economically (Berthold, 1989: 232-235) and politically (Bruckmüller, 1982: 36-38) most influential seigneurial systems in Early Modern Austria. In the first half of the 19th century, the seignury was divided into two administrative districts, Augegend (Floodplain District, FPD) and Waldamt (Forest District, FD). The two manorial farms-treads that organized cultivation of the entire Breuner demesne were both situated in the Floodplain District (Figure 1). One of the manorial farms was integrated into the castle district and part of Kamp village, the other one was embedded in the communal structures of Untersebnarn close to the meandering Danube River. Due to the rich data available, we have chosen these two villages as our central case study to explore biophysical issues of lord-peasant relations. We briefly introduce the socio-ecological characteristics of the two regions (FPD, FD) and the demesne economy contained within the region (GG), before we turn to a description of the two villages.

FPD comprised twelve villages stretching over a total territory of 56 km², while FD contained 20 villages with 92 km² in total (Table 2). Of the total seigneurial territory (148 km²), demesne lands accounted for 29 km² (*i.e.* 20%)¹⁰. In comparison to FPD and FD villages, the demesne lands were densely populated. Forest areas accounted for the largest fraction of demesne land use (c. 60% of the total area), while cropland made up the main share of land used by the peasants (FPD 48% and FD 55%). Demesne forests were primarily used for the extraction of fuelwood for castle and household heating as well as manufacturing and as noble hunting grounds. Cereal yields were quite high in both FPD and FD, whereas yields reported for demesne lands were moderate and close to the Austrian average of c. 920 kg/ha/yr (Krausmann, 2004: 753). Cropland was the dominant land use form, while grassland was of little significance. Livestock density was considerably below the Austrian average of 17 LSU500/km² (livestock units per square kilometer) and also lower than in other cropland regions in Lower Austria (*Ibid.*: 739). Permanent crops (vineyards) and horticulture occupied only a small share of the land, but

10. Further research would be required to give the exact location of the demesne in FDP and FD.

nevertheless were significant in economic terms for subsistence and market production (Bauer & Landsteiner, 2006).

TABLE 2
Characteristics of the socio-ecological system, 1815-1846
(FPD: Floodplain District; FD: Forest District; GG: *Grundherrschaft Grafenegg*;
D: Demesne; R: Rustic)

	FPD	FD	GG	Kamp	Unterseibarn		
				D	R	D	R
Area (km ²)	56	92	29	2	2	1	6
Population (cap)	3,124	7,379	110	104	238	6	351
Population Density (cap/km ²)	56	80	4	53	119	8	59
Share of cropland (%)	48	55	30	79	86	6	93
Share of grassland (%)	16	3	11	11	0.4	3	3
Share of garden/vineyard (%)	1	4	—	4	13	—	4
Share of forest (%)	20	17	59	0.2	0.1	91	0.02
Cereal Yields (kg/ha/yr)	1,562	1,922	788	841	1,181	880	919
Livestock Density (LSU/km ²)	4	4	1	5	7	6	3

Sources: NÖLA (1823a-e, 1829a-g, 1830a-r), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845); Schweickhardt (1834: 15-6). Archival sources on four FPD and three FD villages were not available.

The densely populated village of Kamp encompassed four km² in total. This commune contained the representative Grafenegg castle, a manorial farmstead and adjacent demesne lands, which made up approximately half of the village territory. It contained various parcels of cropland, some grazing and non-agricultural areas, *e.g.* representative gardens. The river Kamp –demarcating the village’s western boundary– intersected the castle district and featured a manorial water mill. The remaining land in the village was leased as rustic land to the village population. A mixture of mostly chernozem and humid black soils provided good conditions for crop production (Fink, 1964: 973). Additionally, river Kamp regularly flooded adjacent areas, depositing vital plant nutrients on agricultural lands. Even though they were ploughing rich soils, the peasant population of the 1830s performed biennial rotations only. On the plots best suited for agriculture (50% of the total cropland in the village) they grew rye and oats (and potatoes after the harvest), while on lesser fertile plots (c. 40% of the cropland in Kamp) again rye alternated with fallow in the second year. To broaden their subsistence portfolio, peasants produced other agricultural products (*e.g.* cabbage, fruits and nuts). Hay and livestock production were of little significance, and grazing areas were relatively scarce (only 0.4% of total rustic land). Accordingly, manure production and management remained relatively under-developed, leaving cereal

yields in Kamp below FPD averages. The peasants applied what little manure there was exclusively to vineyards, as wine production allowed them to participate in market production. Demesne cultivation was more diversified, as manorial farmers grew wheat, rye, barley, oats (and again, potatoes and turnips after the harvest). Additionally, demesne administrators experimented with the cultivation of clover on fallow land, trying to increase fodder availability for livestock. Still, livestock densities in Kamp's demesne were far below Austrian the average of c. 17 LU500/km² (Krausmann, 2004: 739). While peasants depended on a smaller number of oxen and horses as traction animals, manorial farms- teads kept large sheep herds for textile production.

TABLE 3
Farm Types, 1815-1830 (K: Kamp; US: Untersebnarn)

	Manorial Farms		Attendant Farms		Large Peasant		Small Peasant		Small Holder	
	K	US	K	US	K	US	K	US	K	US
No of Farms	1	1	89	—	—	7	15	30	77	98
Ag. Population	4	4	199	—	—	31	67	101	172	219
Total Area (ha)	150	122	70	—	—	97	28	164	92	109
Farm size (ha)	150	122	1	—	—	14	2	5	1	1
Arable (%)	79	6	79	—	—	94	90	93	90	92
Grassland (%)	10	3	—	—	—	2	—	4	—	2
Orchard (%)	4	—	11	—	—	2	4	2	5	4
Vineyard (%)	—	—	10	—	—	1	5	2	4	2
Woodland (%)	—	91	0.2	—	—	0.1	—	—	—	—
Other (%)	10	—	—	—	—	—	—	—	—	—

Sources: NÖLA (1823c, 1823d, 1829f, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

The village of Untersebnarn covered seven km², a territory twice as big as Kamp. Untersebnarn contained only one km² of demesne land and four km² of leased rustic areas. Farms in other villages used two hectares of the land¹¹. Agriculture also found favorable conditions in this commune, as very fertile chernozems intermingled with rich floodplain soils, located in the lower areas close to the Danube. Riparian woods, which made up 90% of the total demesne area in the village, completely covered an island intersected by the main river and a smaller side branch. Manorial interests in Untersebnarn aimed at rich forest

11. Excluded from our calculations on Untersebnarn resource use. On the other hand, 2% of the land area outside the village boundaries of Untersebnarn were considered in our reconstructions, *i.e.* external land used by Untersebnarn residents in the villages Fels am Wagram, Grafenwörth and Wagram am Wagram.

resources (mostly poplars and willows), where landlords held exclusive rights. Demesne agriculture was of minor importance in this village. In contrast to Kamp, triannual rotations including rye, oats, potatoes and turnips dominated rustic land use. Untersebn peasants also engaged in viticulture and wine production, while livestock production and kitchen gardens satisfied household subsistence only. As in Kamp, low livestock densities resulted in a lack of manure for agricultural production (NÖLA, 1829f).

The two manorial farms operating on the demesne cultivated significantly larger land areas per farm than the other farm types within GG (Table 3). Manorial resource use mainly concentrated on production of crops (arable land 79% in Kamp) and forestry (woodland 91% in Untersebn). A minor fraction of grassland (average 7%) was used to feed the sheep herds. Manorial vineyards were negligibly small in Kamp and Untersebn. In contrast, wine (and fruit) production were major components of attendant farms, supplemented by crop production on arable land (79% of the land used per attendant farm), but within a significantly smaller area than demesne arable. To account for pronounced differences among peasants in terms of land endowment, we divided the peasant farms into “Larger Peasants” (> 6 ha per farm) and “Smaller Peasants” (< 6 ha per farm)¹². Unlike attendant farms, large peasants cultivated a higher proportion of cropland per total farm size (94%), mainly concentrating on the production of staple crops, *e.g.* rye, barley, oats and potatoes. Smaller peasants followed a similar production strategy, but on a smaller area per farm (on average 2 ha in Kamp and 5 ha in Untersebn). Smallholders—the largest fraction of the peasant population—cultivated only one hectare per farm on average. The scarcity of grazing land severely limited peasant animal husbandry. Seigneurial control of grazing land was, therefore, a crucial aspect of lord-peasant-relations in GG.

6. ASSESSING THE SOCIAL GEOGRAPHY OF LORD-PEASANT-RELATIONS IN GG

In the village of Kamp, the peasant population had access to only c. 60% of the total arable area, whereas demesne lands accounted for the remaining c. 40% of the area. On the east side of the main road and in the southern part of the village, the manorial farm cultivated comparably large demesne fields (118 out of 290 ha in the whole village) (Figure 3). Most of the remaining demesne fields were geographically integrated around the Kamp castle district and situated next to each other, an important prerequisite for the uninte-

12. Sources refer to a similar distinction between large peasants (*Vollbauern*) and small peasants (*Halblehner*).

rupted and stable cultivation of larger fields within rotation systems. In addition, peasants could more easily transport agricultural products from demesne lands on shorter distances to the manorial farmstead, where products were further processed, distributed or sold. Consequently, the location of the manorial farm provided competitive advantage in terms of transportation costs. Moreover, landlords could afford to use a significant share (c. 10%) of their productive land as recreational area or hunting grounds, rather than for agricultural cultivation. Only a small fraction of demesne arable land was located within the complex amalgam of land plots held by the peasant population. We may assume that these demesne plots were leased by the landlords. Peasant land plots were spread all over the village and highly dispersed, turning the cultivation of fields into a collective challenge for the peasantry. Attendants owned some of the highly fragmented and small field plots in the northern and western part of the village (average farm size 1 ha, in total 55 ha), mostly cropland (79%) but also a relatively high share of orchards (11%) and vineyards (10%). The fifteen Kamp peasants ploughed approximately one and a half hectares of arable land per farmstead (26 ha in total). Only a few were able to access land plots in the vicinity of the town center (below the castle district), forcing them to transport produce longer distances than demesne cultivators. The 77 smallholders in Kamp cultivated a total amount of 92 hectares (*i.e.* almost 50% of the total village area), again mostly arable (90%) concentrated in the middle section of the village. Similar to attendant farms, smallholders cultivated one hectare per farm, but were excluded from orchard and vineyard cultivation and seigneurial services¹³. Land cultivated by residents of other settlements, played a negligible role in Kamp.

While the land tenure map of Kamp clearly shows the pronounced differences in access to land between the different farm types, Untersebnar geography appears to have been more complex in terms of land tenure. But in contrast to the other village, land seems to have been more equally distributed between farm types (Figure 4). Here, the vast majority of the village population had access to approximately 80% of the total land area. The extent of demesne land use is one of the most striking differences between the center of GG and the more peripheral village. In Untersebnar demesne lands accounted for 122 hectares, c. 90% of which was covered by alluvial forest on the Danube island in the southern part¹⁴. The riparian forest with its high increment and short rotation cycle provided fuelwood for manorial brick production. Demesne arable comprised just 8 out of 351 ha, was highly dispersed across the village and therefore was of minor importance.

13. The farm sizes we found were very similar to those in France (JESSENNE, 1999: 258) and Spain (PARCERISAS, 2014). Only in England, bigger peasant farms were reconstructed (ALLEN, 1992: 62).

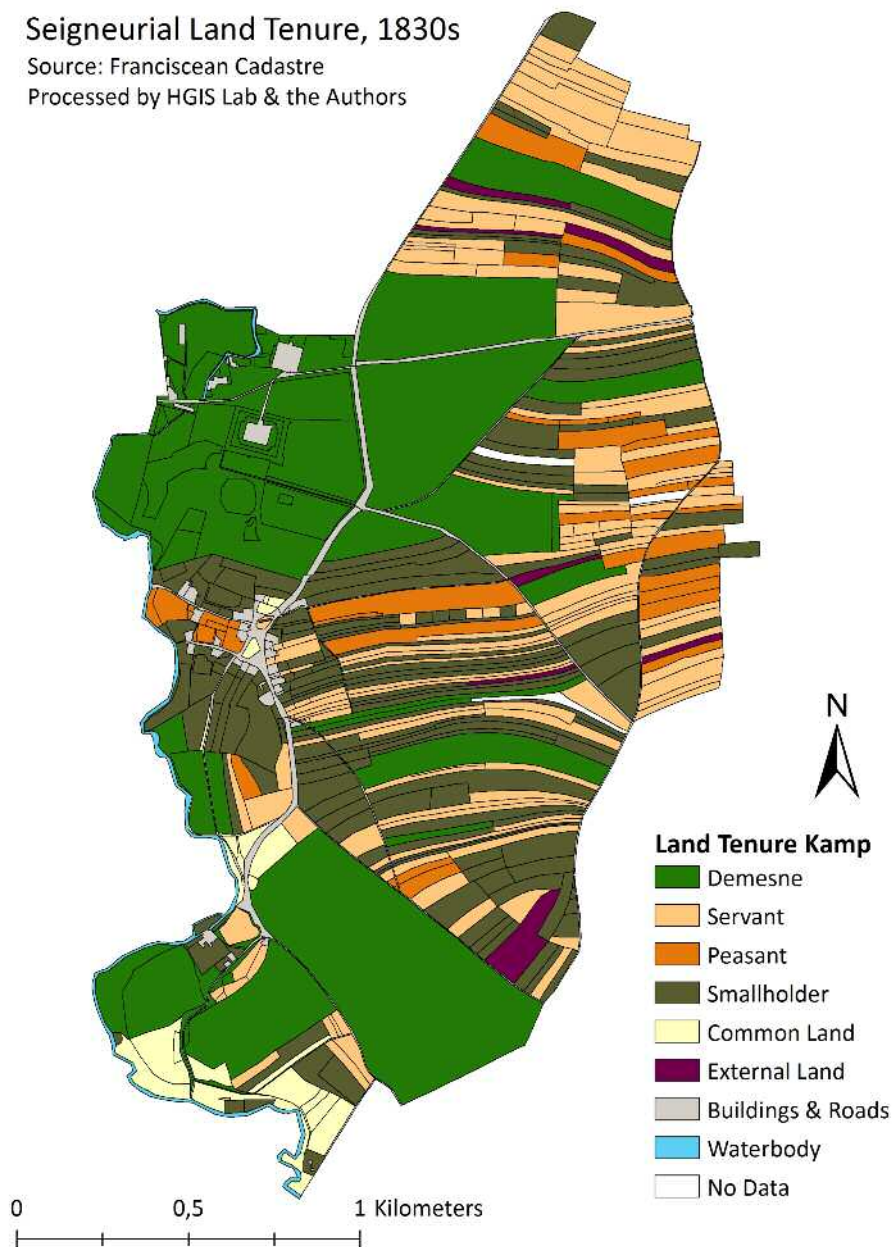
14. Demesne woodland may have even been larger, but there was no data available on the south-eastern part of the island.

FIGURE 3
Seigneurial Land Tenure Kamp, 1830s

Seigneurial Land Tenure, 1830s

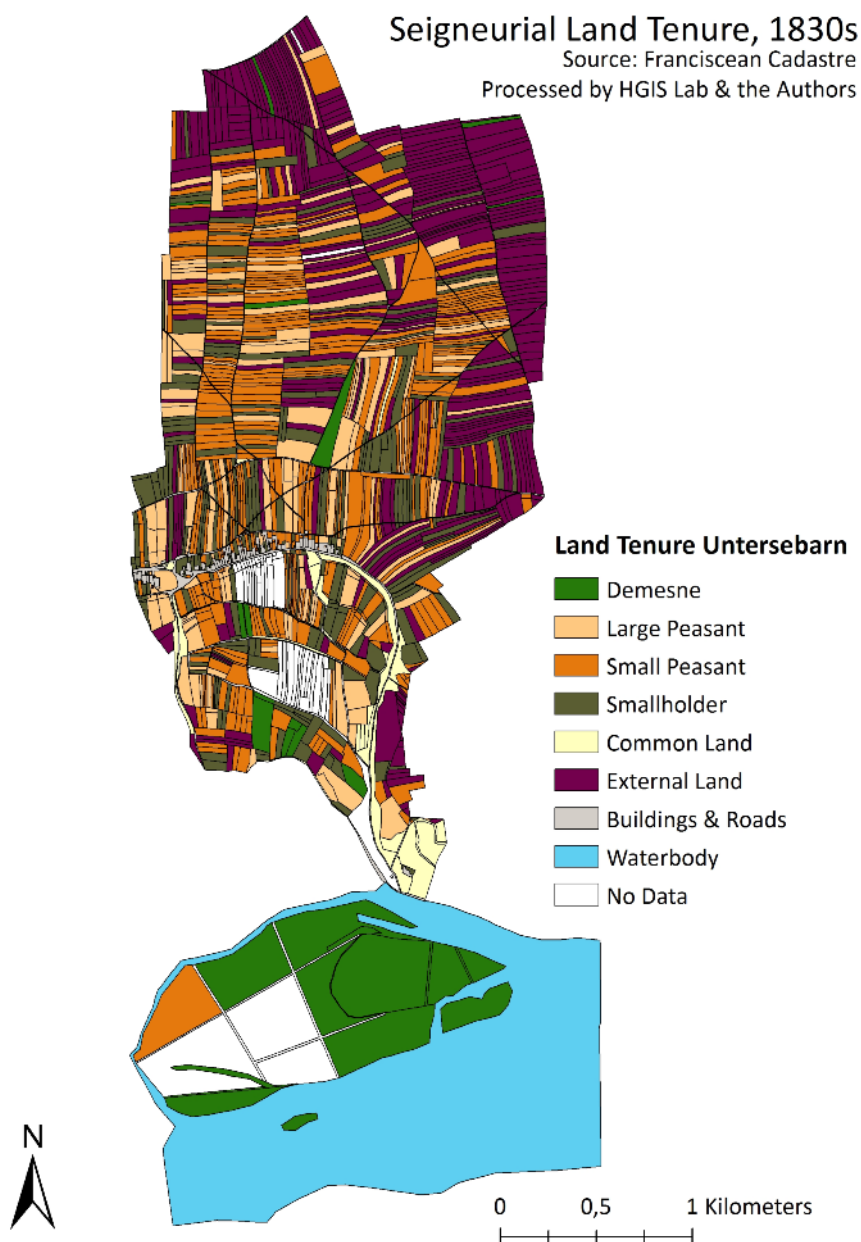
Source: Franciscan Cadastre

Processed by HGIS Lab & the Authors



Source: Franciscan Cadastre; processed by HGIS Lab and the authors.

FIGURE 4
Seigneurial Land Tenure Untersebnarn, 1830s



Source: Franciscan Cadastre; processed by HGIS Lab and the authors.

Similar to Kamp, grazing areas were relatively scarce (8 ha) –and almost 50% were under manorial control. Cropland was the most dominant land use type in Untersebnarn, accounting for 50% of the total village area. Again, smallholders formed the largest fraction of the total population and cultivated plots no larger than one hectare each, mostly to produce cereals. Smaller peasants cultivated five hectares per farm on average, 93% arable and 3% for wine and fruit production. The seventeen larger peasant farms in Untersebnarn cultivated an average of 14 hectares each, with geographically more integrated land plots than smaller peasants and smallholders. None of Untersebnarn's residents served as manorial attendant farmers. Approximately 30% of the total area was reported as external land (*i.e.* land cultivated by peasants of other villages).

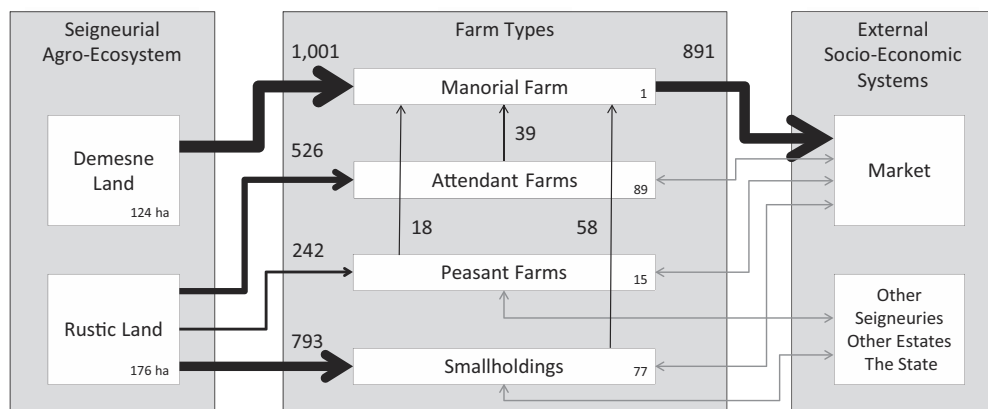
7. BOUNTIFUL HARVEST OR FOOD FOR A FEW?

In a next step, we looked at annual agricultural food production output and its distribution within the seignury. We measured production and supply of plant- and animal-based food in terms of nutritional energy value (gigajoule nutritional value –GJNV, see Appendix for further details). Figures 5 and 6 show the flows of food for Kamp and Untersebnarn, respectively. The vast majority of the inhabitants (181 farms in total) in the central village of Kamp had only limited access to the food produced within the seigneurial land use system. Production of food on the manorial farmstead accounted for c. 40% of the overall production in the village. In absolute terms, a total amount of 1,001 GJNV/yr were produced on 117 ha demesne lands. In addition to their own demesne production, landlords regularly received feudal rents collected from attendant families, peasants and smallholders, accounting for 115 GJNV/yr in total. Attendant families delivered 39 GJNV/yr to landlords, peasants 18 GJNV/yr and smallholders 58 GJNV/yr. On average, feudal rents accounted for 7.5% of aggregate food production of each of the tenants¹⁵. This collection of feudal rents and taxes supported the market-oriented demesne economy. In total, a substantial fraction of the food available in Kamp (891 GJNV/yr) was extracted by the landlords and sold on markets outside the seignury to provide for a sizeable monetary income. In contrast, the 89 attendant farmsteads produced 526 GJNV/yr on a substantially smaller land area (62 ha). Peasants (15 farmsteads in the whole village) produced 242 GJNV/yr on 26 hectares, and the 77 smallholders produced 793 GJNV/yr from 88 hectares. In terms of land productivity (*i.e.* food produce per unit of agricultural land), demesne agriculture was less productive than most of the peasantry. Food out-

15. For the region of Lower Austria in the 16th century, KNITTLER (1989: 57) estimated that the share of rents would make up for 15.2% of the total manorial income. Here, we find a share of 11.5% in relation to the total production on the demesne arable.

put on the demesne was 8.1 GJNV/ha/yr, while peasants and smallholders achieved around 9.3 GJNV/ha/yr and attendant farms 8.5 GJNV/ha/yr¹⁶.

FIGURE 5
Food Production and Allocation in Kamp, 1830 (GJNV/yr)



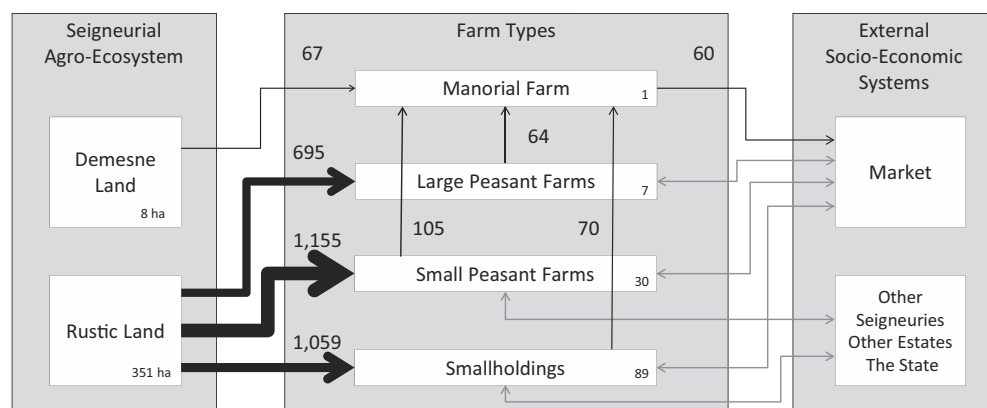
Sources: NÖLA (1823c, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

In contrast to the highly productive demesne economy in the central village of Kamp, the production of food on the manorial farmstead was negligible in Untersebnarn (67 GJNV/yr extracted, almost all sold on markets), as manorial resource use primarily was concerned with exploiting the riparian woodlands (Figure 6). Here, feudal rent made up for an aggregate value of 239 GJNV/yr (*i.e.* 9% of the total food produced), slightly more compared to Kamp. Seven larger peasant farms (*i.e.* > 6 ha) extracted 695 GJNV/yr on 93 hectares of rustic land, 30 smaller peasant farms (*i.e.* < 6 ha) extracted 1.155 GJNV/yr on 154 hectares of land and 89 smallholders produced 762 GJNV/yr edible biomass on 104 hectares of rustic area. In sharp contrast to the center of GG, manorial and peasant agriculture were relatively similar in terms of area productivity in Untersebnarn. Average food productivity per unit of demesne land was almost the same (8.3 GJNV/ha) as on Kamp demesnes, whereas productivity of larger and smaller peasant farms accounted for only 7.5 GJNV/ha. Smallholders in Untersebnarn undertook a slightly lesser productive agriculture, as the average productivity was 7.3 GJNV/ha. Accordingly, area productivity on Untersebnarn rustic land was significantly lower than in the central village of Kamp. If we recall physiocratic ideas as represented in Johann Wiegand's diagnosis (see Introduction), our findings leave a mixed impression. In Kamp, landlord land productivity was even

16. Using slightly different methods, GINGRICH *et al.* (2015) and KRAUSMANN (2004) find values between 2.9 and 6.2 GJNV/ha/yr in similar agro-ecological zones.

lower than the tenants' figures suggest, but in Unterseebarn we arrive at the opposite conclusion. Accordingly, the question of agricultural productivity needs further elaboration.

FIGURE 6
Food Production and Allocation in Unterseebarn, 1830 (GJNV/yr)

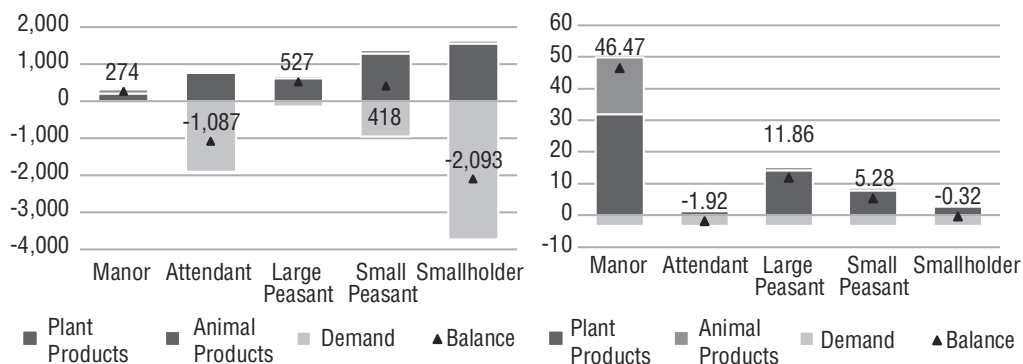


Sources: NÖLA (1823d, 1829f), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

In a subsequent step, we calculated food budgets for each of the farm types to compare the amount of food available with the standard metabolic requirement, *i.e.* food energy required to sustain the household or individual. Average food requirement per capita is dynamic and varies with age, weight and activity. We use an average of 3.36 GJNV derived from an estimate for a European village in the late 18th century, which calculated an average of 8.8-9.3 MJ per capita per day (Freudenberger, 1998; Smil, 2000: 236-7). In spite of some uncertainty, food budgets provide a rough indication of food distribution across farm types, how subsistence needs were met in different farm households, and the deficits and surpluses that could be sold on markets. Even if we take into account that our estimates of food production probably underestimate actual production by 10-20% and that the upper range of assumptions for food demand may overestimate by 10-20%, food budget patterns for the different farm types remain robust (see Appendix for further details). Our estimates (Figure 7) suggest that manorial agriculture yielded a relatively high energetic surplus of 274 GJNV/yr per household and 45 GJNV/yr per capita. Moreover, manorial final consumption contained a significantly higher proportion of animal products (36%) compared to peasant diets (5%).

FIGURE 7

Food Budgets per Farm Type (left) and per capita (right) (GJNV/yr)



Sources: NÖLA (1823c, 1823d, 1829f, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

GG attendant families cultivated a significantly smaller land area in terms of total land in use and also per individual farmstead. Even though their agricultural production accounted for half of the manorial production on a substantially smaller land area, attendant farms yielded a drastic deficit in terms of final food available (-1.087 GJNV/yr per household and -1.9 GJNV/yr per capita). Therefore, food production in attendant units only provided for c. 40% of individual and household aggregate metabolic needs. We assume that attendant families covered their remaining nutritional requirements with food bought on local markets, which was possible because they received wages in money for their labor and seigniorial services and produced a comparably large quantity of marketable products compared to the other peasants (above all, wine). Large peasant farms – only 7 households in the region – yielded an annual surplus of 527 GJNV/yr per household and 12 GJNV/yr per capita. Their production not only met subsistence needs but also produced a significant surplus potentially available for local market participation. Theoretically, large peasant farms were able to sustain another 3.5 inhabitants on average¹⁷. Smaller peasant farms cultivated an average of 3.5 ha of rustic land. While the total amount of plant and food production sufficed to satisfy their subsistence needs, their surplus was smaller and could theoretically have supplied 1.6 more persons on average. Practically, this relatively small amount of food surplus was needed to compensate for a bad harvest

17. Given the fact that we could not account for additional farmhands, wage workers or handmaidens our estimate seems plausible. HARNISCH (1980: 129-130) gives a similar estimation for average households of larger peasants.

season and likely did not represent a stable monetary income. Accordingly, market integration of smaller peasant farms seemed the exception rather than the norm. Finally, our empirical findings suggest that smallholders yielded a significant food deficit of -2.093 GJNV/yr for all the households, even accounting for a negative food balance at the level of individual metabolic needs (-0.3 GJNV/yr per capita). Similar to the attendant farm metabolism, smallholders were not able to produce enough food on their own land to sustain themselves (only 45% of their aggregate metabolic needs)¹⁸. Hence, smallholder subsistence strategies need further elaboration. Therefore, we will turn towards the most crucial resource at the disposal of the peasants –their labor time (Landsteiner, 2010).

8. AGRICULTURAL IDLENESS OR WORKING POOR?

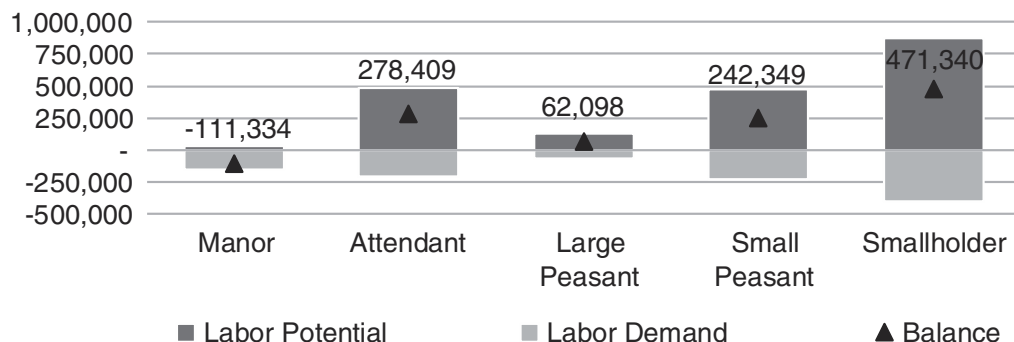
As demesne lands were relatively large in area but scarce in population, sufficient labor was often a bottleneck for demesne cultivation. To assess the complex relationships between demesne cultivation and peasant labor force we estimate rough labor time budgets for each of the farm types involved. Therein, we compare a maximum labor potential available on different farm types (assuming ten working hours per day and 298 working days per year for the economically active population, expressed as the sum of the agricultural workforce in all households) with the demand for agricultural labor estimated on the basis of land use patterns and time needed to maintain livestock and reproduce infrastructure (see Appendix for further details).

The few permanent residents of the manorial farms supplied approximately 36,000 working hours per year, compared to a labor demand of c. 110,000 working hours required to cultivate the entire demesne in Kamp and Untersebnarn (Figure 8). Obviously, the peasant population of GG largely covered this demand: attendant units were relatively high in numbers, but their surplus labor time (278,000 h/yr) was largely bound up in demesne management and specialized tasks, *e.g.* sheep herding and breeding, forest management, milling, brewing, etc., and not available for demesne agriculture. Larger peasant farms cultivated a significantly higher share of land per farmstead, so they could not provide much surplus labor (62,000 h/yr) either. Accordingly, labor for the cultivation of demesne land was predominantly supplied by smaller peasant farms and smallholders. Being endowed with lesser land resources, smaller peasant farms had a potential of 242,000 h/yr and smallholders a potential of even 471,000 h/yr available for agricultural

18. The nutritional deficits were even more pronounced than in a neighbouring Habsburg province (GINGRICH *et al.*, 2015). HENNING (1969) and TOPOLSKI (1994) provide similar impressions of negative household budgets from a socio-economic perspective.

work on the demesne. We assume that the latter two invested considerable fractions of their labor time surpluses in service of GG landlords (*e.g.* on the demesne lands and manufactures), as they needed to yield either wages in kind and/or money to cover the nutritional deficits under conditions of severe subsistence pressure.

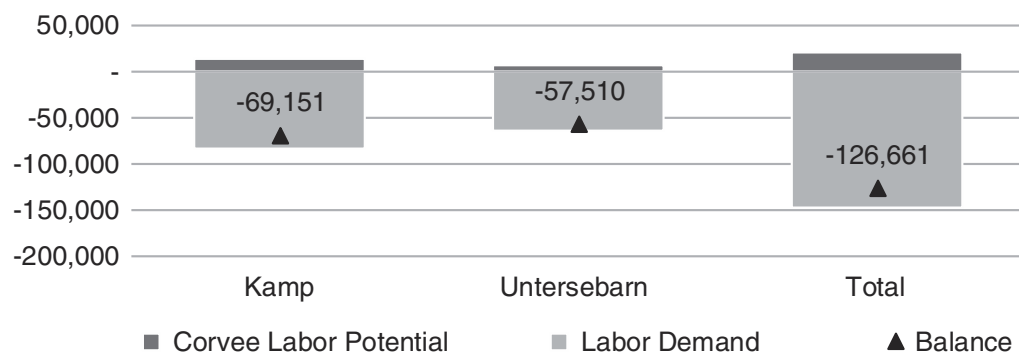
FIGURE 8
Labor Budgets per farm type, 1830 (h/yr)



Sources: NÖLA (1823c, 1823d, 1829f, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

As part of the seigneurial system of agriculture, peasants were obliged to perform labor services on demesne farms (*i.e.* compulsory *corvée*-type labor) in return for the land tenure granted by the landlords. We may assume that this type of labor “contract” was mostly used to cover labor demand on the manorial farmsteads. But our findings suggest that in the first half of the 19th century compulsory labor played only a marginal role in GG (Figure 9). In Kamp, the landlords claimed roughly 14,000 hours of unpaid labor, whereas 83,000 h/yr would have been needed to cultivate Kamp demesne lands (*i.e.* only 17% of the demesne labor demand was covered by *corvée*). Untersebnarn reconstructions yield a similar result, as 7,000 h/yr supplied drastically fell below the 64,000 h/yr demand (only 11% of compulsory labor). Therefore, we may assume that *corvée*-type labor was already of little significance in the first half of the 19th century. Consequently, peasants working on the manorial farmsteads were compensated with either wages in kind or monetary wages. This argument is strongly supported by additional archival material, indicating that wages for farm workers were among the most important manorial expenses (*Gutsverwaltung Grafenegg*, 1843). Also, we may assume that some of the larger peasants compensated for their *corvée* duties with monetary payments, which they generated on local markets.

FIGURE 9
Corvée-type of compulsory Labor at Manorial Farms, 1843 (h/yr)



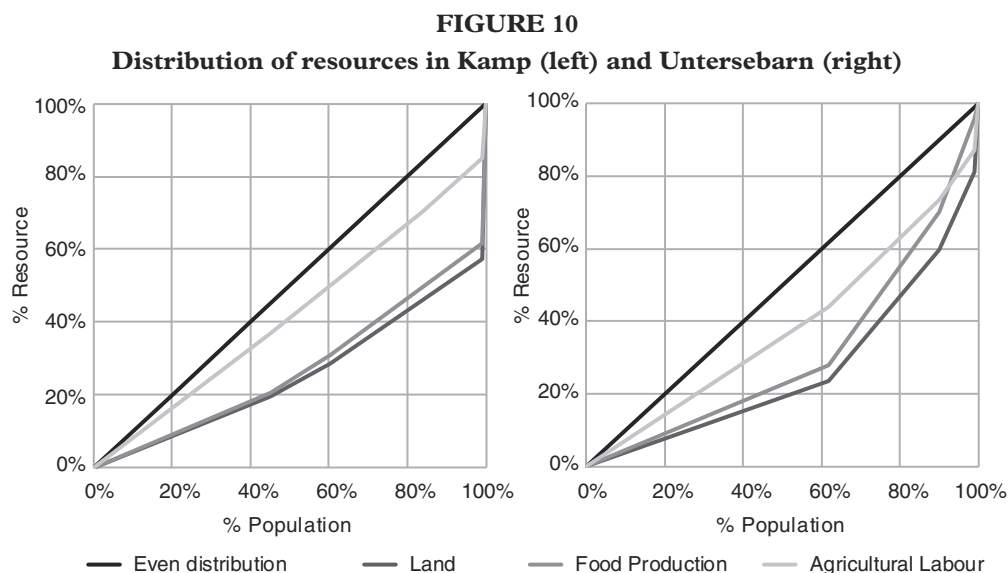
Sources: NÖLA (1823c, 1823d, 1829f, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

9. THE UNEQUAL DISTRIBUTION OF LAND, FOOD AND LABOR IN SEIGNEURIAL SYSTEMS

In this paper we have presented a first attempt to conceptualize and empirically scrutinize the production, distribution and consumption of crucial agrarian resources within seigneurial agriculture from a socio-ecological perspective. We have seen that the three central resources of pre-industrial agriculture were distributed unequally within seigneurial agriculture (Figure 10). Lorenz curves show what percent of the local population (as aggregate value of all farm types) enjoyed access to what percent of the resources, referring to an “even” distribution. Striking inequalities appear in terms of land access, as reflected by the very different types of land tenancy –demesne and rustic land. Food production, which was heavily dependent on the accessibility of land, was similarly unequal. In contrast, inequality in terms of access to agricultural labor appears less pronounced, as we have seen a significant labor time surplus in the overall system¹⁹. Interestingly, the Gini coefficients –measuring the relative inequality in distribution of variables within a given population (Badía-Miró & Tello, 2011; Tello & Badía-Miró, 2014)– for the two villages are similar –yet with quite different cumulative frequency distributions. The Gini coefficient of Kamp was 0.49 and Untersebnarn 0.47, which indicates that inequality at the village scale may have been less significant compared to the inequalities between the different agrarian agents²⁰. These differences at the farm scale need further elaboration.

19. We have to keep in mind our assumptions on potential labor spent (Table 1). Actual labor time invested may be significantly lower.

20. The very different cumulative frequency distributions shown in Figure 10 are not captured by the



Sources: NÖLA (1823c, 1823d, 1829f, 1830l), *Gutsverwaltung Grafenegg* (1815, 1817, 1818, 1820, 1825, 1830, 1835, 1845).

Regarding farm size, we have seen a pronounced hierarchy, which severely affected peasant resource use strategies in the village of Kamp. In Untersebnarn, land resources were monopolized according to specific seigneurial interests only (primarily firewood extraction from the alluvial forest for burning marketable bricks), leaving a significantly larger fraction of rustic land to be divided among the different farm types. Polarization was clearly lower than in Kamp, in spite of the similar Gini indices. With respect to food production, socio-ecological inequalities were similarly striking. Peasants endowed with enough land (in our case study, more than six hectares per farm) were able to produce sufficient quantities of food to sustain the family household, and even additional farmhands. Furthermore, their agricultural surplus likely allowed for regular market participation, competing with agricultural products from the seigneurial economy. Still, this group made up only 2% of total households in the region. In contrast, peasants with a farm size under six hectares (c. 15% of the total population) only produced a modest surplus, *i.e.* market participation may be considered exceptional on these smaller farms. But the majority of the population (c. 80%) underwent certain degrees of subsistence pressure, as landlords claimed approximately a third of the total food produced from the lo-

quite similar Gini coefficients, and are better reflected using Theil indices: 0.22 in Kamp and 0.10 in Untersebnarn. Furthermore, Theil indices would allow decomposing in future among the *in between* and *in within* components of these inequality profiles.

cal land use system. Our food budgets indicate that attendant units and smallholders were unable to satisfy their family or individual metabolic reproduction, as only c. 40–45% of their minimum demand was supplied from their leased plots. Attendant families were primarily engaged in seigneurial service to create monetary income, guaranteeing their subsistence with marketable goods. In their case, agricultural land use was a supplementary source of income—a part-time activity—in which they might have invested significant parts of their potential labor surplus. In sharp contrast, smallholders were fundamentally dependent on food production on their small rustic land plots. Consequently, they actively participated in wage labor on GG farms or manufactures to compensate for their nutritional energy deficit, which created structural dependencies on the seigneurie. By being the largest employer in the region, GG provided for the single source of a relatively stable monetary income granted for the work performed in seigneurial service. Similarly, being the most important supplier of agricultural products, GG supplied sufficient marketable food that could be bought on local markets to compensate for the metabolic deficits. This meant that GG not only drained food from their subjects, but also significant fractions of their (modest) monetary income, which peasants needed to “buy back” some of the food that they had produced earlier. It is even likely that the former could systematically take advantage of the high spring prices of grains, while the latter were always caught by the low post-harvest prices in summer. Economic Historian A. Hoffmann (1958) showed similar dynamics of seigneurial market monopolization for another Habsburg province. The same mechanism has been found in other parts of Europe in the 19th century (Aymard, 1983; Tello, 2007) and developing countries, such as India in the 20th century (Bhaduri, 1983).

On the other hand, GG landlords were also dependent on their subjects, as attendants and smallholders provided for sufficient quantities of labor time, which was required to run the demesne cultivation. Smallholders were primarily engaged in demesne cultivation (*i.e.* the agricultural work force), mostly within waged labor contracts, and only partially within *corvée*-type labor obligations. In sharp contrast to our first assumptions, smallholder labor surplus was significantly higher than the cultivation of the demesne needed (only 30% of the smallholder labor surplus sufficed to cultivate the entire demesne). So we may assume that peasants were competing heavily on the local labor markets. Also, the relative surplus in peasant labor time may help to explain why smaller farms were able to perform the most productive agriculture among all the farmsteads involved. In Kamp, we have seen that the lesser endowed peasants and smallholders showed the highest land productivities, indicating an additional strategy of land use intensification to compensate for food deficits and family labor surpluses, *i.e.* they were investing more labor time per capita and land unit to produce a maximum amount of heavily needed food. In contrast, the manorial farmsteads allocated their resources in a much more extensive manner. In-

centives for the landlords to intensify agricultural land use were nearly absent, as investment of more wage labor and/or other ways of raising area productivity (cultivation of leguminous plants, shortening of fallow periods, more efficient technology, etc.) would have raised annual factor costs for GG landlords. But, if market incentives had changed (e.g. a growing demand for cash crops) landlords were more flexible, as they had much more resource capital at their disposal.

We would like to conclude with some thoughts on the broader discussion on agrarian change and land use intensification before the onset of the industrial transformation. There are two dominant lines of argumentation here. On the one hand, Ester Boserup's (1966) *population push* identifies increases in population density as a driver of agricultural intensification with innovative agricultural practices. On the other hand, Netting (1993) criticized this approach for its neglect of market forces, while Badía-Miró and Tello (2014) and Parcerisas (2014) discussed the pressures of external markets and improved transportation networks as *market pull* effects. Looking at seigneurial systems –and the distinct lord-peasant-relations they entailed– may provide a more complex picture. As we have seen with family-based smallholder households, which were dependent on a *peculiar equilibrium between family demand satisfaction and the drudgery of labor* (Chayanov, 1966: 6), there was little other than labor time for markets to pull away. On the manorial farms we found the opposite situation, namely a large agrarian surplus combined with a need for additional working hands. This *symbiotic relationship* (Hoyle, 2010: 360) between lord and peasant farms calls for a closer examination of the social relations pulling them together.

In his heavily discussed 1976 contribution, Robert Brenner introduced the concept of *Surplus Extraction Relationship* (Ashton & Philpin, 1987; Brenner, 1976), which refers to *an unpaid-for part of the product [that] is extracted from the direct producers by a class of non-producers* (Brenner, 1976: 31). This surplus extraction lead to

an emergence of the classical landlord-capitalist-tenant-wage labor structure, which [...] was the indispensable precondition for significant agrarian advance, since agricultural development was predicated upon significant input of capital, involving the introduction of new technologies and a larger scale of operation (Ibid.: 63).

Considering the large surpluses extracted and the comparably large scale of the demesne economy in our case study, we may conclude that GG landlords played a significant role in agrarian change in our case study region. But the surplus extracted in one part of the socio-ecological system leaves a situation of *Structural Scarcity* (Homer-Dixon, 1999) in another part, which invokes a more efficient and even more intensive use

of resources among the subjected peasantry. The production of more resource on the same –and limited– land area may have created severe consequences for the surrounding agro-ecosystems, as intensification usually comes at the cost of long term environmental degradation (González de Molina & Toledo, 2014: 277). To investigate the ecological impacts of either “Peasant Path” or “Landlord Path” dynamics of agrarian change, information on the soil ecosystem properties would be required. In a next step, we will try to include soil system information to expand our preliminary knowledge of the intricate relationships of seigneurial surplus extraction, structural scarcities and the consequences for the agrarian resource base in pre-industrial Europe.

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APPENDIX: METHODOLOGY

To reconstruct biophysical relations within seigneurial agriculture we have integrated two different bodies of archival material –the fiscal source *Franziszeischer Kataster* (FK) and manorial accounting records *Naturalhauptbuch* (NHB). In a first step we converted information in historical physical units into metric units by applying appropriate conversion factors (Gingrich & Krausmann, 2008; Guzmán *et al.*, 2014; Krausmann, 2004, 2008). In a next step, we digitized cadastral maps to reconstruct land access. Using “Historical Geographic Information Systems”, which received broader academic attention and application recently (Campbell & Bartley, 2006; Donahue, 2004; Gregory & Ell, 2007; Cunfer, 2005; Knowles, 2002, 2008), digitized maps were georeferenced, *i.e.* historical landmarks were assigned with real world coordinates, and synthesized with information derived from the parcel protocols (PP) on land tenure. Afterwards, we were able to map out land tenure according to the different farm types involved. Finally, we created land tenure maps to shed more light on the social geography of lord-peasant-relations at the village level.

In a second step, food production and supply for each of the farm types was calculated based on information provided in CSE, PP (for peasants) and NHB (for landlords). Vegetal food production was assessed by deducing seed output and processing losses from gross crop harvest, and food of animal origin was calculated based on livestock numbers and productivities, which were estimated from both NHB and FK. We used this data to calculate the amount of livestock products (meat, milk and eggs). From total food production (*i.e.* the sum of vegetal and animal produce), we subtracted feudal rent from peasant farms and added them to manorial balances. Vice versa, wages in kind were considered part of the peasant production and excluded from the manorial supply. Similarly, seigneurial trade relations were included in our calculations. No data was available on peasant external rents and trade relations. All biomass flows were expressed in kilograms per year. After that, we used information derived from PP to reconstruct total demesne and rustic land use in the region. These average figures were combined with PP information on land endowment of the different farm types portrayed in our model. We were thus able to reconstruct aggregate food flows for standardized manorial, attendant, peasant and smallholder farms, expressed in nutritional value. Information on average household size was considered to calculate per capita food availability (*Gutsverwaltung* Grafenegg, 1778). To reconstruct manorial food budgets, the sum of demesne harvest, feudal rents and imports was calculated. After that exports, wages in kind and seeds were subtracted for each of the two manorial farmsteads. Demographic information on household size in the region was used to estimate yearly food demand per farm type (*Gutsverwaltung* Grafenegg, 1778). Peasant food budgets were reconstructed as the product of harvest and wa-

ges in kind, subtracted by feudal rents and seeds flowing back into the rustic agro-ecosystem. No data was available on additional farmhands and maidens. Household size of different farm types were roughly differentiated according to Schaschl (2007).

Finally, to analyze the distribution of labor time within seigneurial systems, we linked information on biomass flows with time invested in the production and processing of plant and animal products (Hitschmann, 1920: 64-8). Potential labor supply was estimated based on average workforce available per farm type. Assuming an average value of ten working hours per capita and day, and assuming an average of 298 work days per year total potential labor supply was reconstructed in working hours per year (Schaschl, 2007: 40). Again, we used information on average household size in the region to reconstruct per capita values (*Gutsverwaltung Grafenegg*, 1778). Labor demand was estimated based on land use information for demesne and rustic land. Information on average working hours per land use type were combined with information on working time needed for animal husbandry as well as maintenance of infrastructure. We assumed that peasants invested their remaining labor time on the demesne. We cross-checked our assumptions with archival material on compulsory labor (*corvée*) availability (*Gutsverwaltung Grafenegg*, 1843). Assumptions on labor potentials may vary substantially between different demographic groups and also between agricultural activities. Also, we have to stress that the labor potential do not reflect actual labor time invested, but provide for a rough indication of labor available in the two villages at stake and should be considered rather a maximum potential than an average. The real labor potential may have been lower because administrative tasks, manufacturing and other subsistence activities (*e.g.* hunting or collection of fruits and nuts) were not considered. Additionally, assumptions on labor demand excluded time spent to collect and transport the harvest and on manorial farms other than on the GG demesne. Still, our time budgets provide for a first approximation on labor time availability in the two villages of Kamp and Untersearn.

Our methodological approach entails a number of assumptions and uncertainties, which need to be highlighted: 1) Territorial boundaries were drawn according to land ownership, *i.e.* every parcel belonging to a household located in the villages was considered part of the seigneurial agro-ecosystem. Land cultivated by subjects of other seigneurial systems or by farms located in other villages (external land, *Überlandgründe*) was therefore excluded from our calculations. Conversely, external land use by seigneurial subjects in our case study should be integrated into the calculations. However, information on external land use was only fragmentary and could not be taken into account. According to a sample taken (NÖLA, 1823a, b, e) this land use was of minor importance in our region (*e.g.* 1.8% external arable land of total arable land) and therefore we assume that this leads to only minor underestimates. 2) Information in NHB does not contain expli-

cit spatial reference. We had to calculate average production for the whole manorial system and relate it to aggregate information on total demesne land use (Schweikhardt, 1834: 154-64). Within our calculations we had to rely on average information on manorial productivity to reconstruct average demesne land use in two villages only. Accordingly, our calculations may not be representative for the overall system. 3) At this stage, our approach neglects monetary aspects of production and consumption within seigneurial systems. As Economic Historian Alfred Hoffmann has pointed out, Austrian seigneuries often operated as *economic lordships* (*Wirtschaftsherrschaft*), in which landlords aim at establishing a socio-economic monopoly over their subjects via comprehensive market rights and commercial privileges (Hoffmann, 1958: 124). As we were primarily interested in biophysical aspects of manorial and peasant subsistence, we decided to focus on biophysical flows only and leave out aspects of *Wirtschaftsherrschaft* here. 4) Fragmentary and uncertain primary data: Assumptions on average production within the region may underestimate productivity in the villages at stake. Also, information on household size remains fragmentary. Finally, information on livestock numbers was only available at the village level and had to be allocated on the different peasant farmsteads. 5) Farm types distinguished are determined by information available from the sources, but do not reflect complex historical realities. Still, we decided to construct standardized model farms to understand systemic interdependences and feedbacks within *Grundherrschaft* Grafenegg.